3.6 Concentration of solutions

Concentration is the amount of solute dissolved in a unit volume of solution. The amount of solute is usually measured in moles and the unit volume is usually one litre (1 dm^3).

The mass of one **mole** of sodium chloride, NaCl, is 58.5 g. This is the **molar mass** of sodium chloride. To prepare a sodium chloride solution with concentration of exactly 1 mol dm^{-3}, one mole (that is 58.5 g) of sodium chloride is placed in a volumetric flask and distilled water added until the volume of the solution is exactly 1 dm^3.

Aim

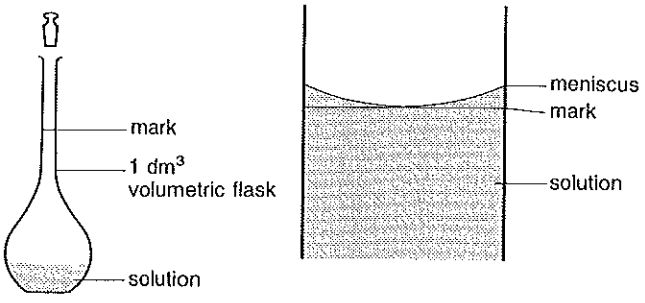
To prepare 1 dm^3 of a sodium chloride solution of concentration 1 mol dm^{-3}.

Apparatus and materials

Volumetric flask, 1 dm^3	Funnel
Stopper	Glass rod
Beaker, 100 cm^3	Dropping pipette
Balance	Sodium chloride, 58.5 g
Wash bottle	Distilled water

Procedure

1 Weigh out accurately into a beaker 58.5 g of sodium chloride.
2 Add the sodium chloride to about 50 cm^3 of distilled water. Dissolve the solute by stirring with the glass rod.
3 Pour the sodium chloride solution into the volumetric flask using a funnel. Add distilled water to the undissolved solid in the beaker and pour this into the flask too.
4 Rinse out the beaker with more distilled water and pour the washings through the funnel into the flask.
5 Add more distilled water to the volumetric flask. Use a dropping pipette to add the final few cm^3 to make up the solution to the 1 dm^3 mark on the flask.
6 Stopper the flask and shake the solution.



Extra Work

- Make magnesium sulphate and potassium chloride solutions with concentrations of 1 mol dm^{-3}.
- Make sodium chloride solutions of concentration 1 mol dm^{-3} using 100 cm^3 and 250 cm^3 volumetric flasks and the appropriate amounts of solute.

Questions

1 **a)** Why is the distilled water not heated to make the sodium chloride dissolve faster?
b) Why is a volumetric flask washed out with distilled water before use?
c) Why is distilled water used in this experiment rather than tap water?
d) Why is it necessary to shake the volumetric flask at the end of the preparation?
e) Why is a dropping pipette, and not the wash bottle, used to make the final few cm^3 of solution up to the mark on the volumetric flask?

2 Copy and complete the following table by calculating the mass of the given compound needed to make a solution of the volume and concentration shown.

compound	volume of solution/dm^3	concentration of solution/ mol dm^{-3}	mass/g
Na_2CO_3	1.00	0.50	
$AgNO_3$	2.00	0.10	
NaOH	0.50	2.00	
$CuSO_4 \cdot 5H_2O$	2.00	0.20	
KCl	5.00	0.25	

3 What is the concentration of the following solutions in mol dm^{-3}?
a) 1.60 g of Na_2CO_3 in 200 cm^3 of solution.
b) 2.00 g of NaOH in 1 dm^3 of solution.
c) 36.50 g of HCl in 500 cm^3 of solution.
d) 3.32 g of KI in 100 cm^3 of solution.
e) 7.90 g of HNO_3 in 250 cm^3 of solution.